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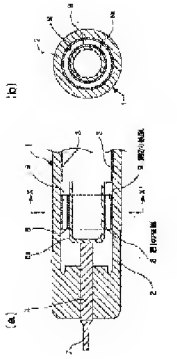
(54) COLD CATHODE LAMP AND ITS MANUFACTURING METHOD



(57)Abstract:

PROBLEM TO BE SOLVED: To provide a cold cathode lamp capable of immediately starting even in the dark of a periphery illuminance of 0.1 lux or below.

SOLUTION: The cold cathode lamp is provided with the glass tube 2 in which a phosphor layer 3 is formed on inner surface thereof, electrodes 5a are provided at both ends thereof, and an enclosed material is sealed in. A first coating 8 consisting of a metal for promoting startup is provided at least onto one of the electrode 5a. By providing a second coating 9 consisting of the metal for promoting the startup on the inner surface of the glass tube 8 in proximity to the first coating 8, a weak discharge is generated between the second coating 9 and the electrode 5a or between the second coating 9 and the first coating 8.

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CLAIMS

[Claim(s)]

[Claim 1] the cold cathode lamp which prepared the electrode in the both ends of the glass tube with which the fluorescent substance layer was formed in the inner surface, and sealed the enclosure matter -- it is -- one [at least] electrode -- start-up assistance -- public funds -- the inner surface of said glass tube [the 1st coat which consists of a group is prepared and / near one / said / electrode] -- said 1st coat -- approaching -- start-up assistance -- public funds -- the cold cathode lamp which prepared the 2nd coat which consists of a group.

[Claim 2] The cold cathode lamp according to claim 1 in which the 2nd coat was formed in the location which does not lap with said fluorescent substance layer formed in the inner surface of a glass tube.

[Claim 3] The cold cathode lamp according to claim 1 or 2 with which the configuration of said electrode prepared said 1st coat in the periphery by the shape of a tube.

[Claim 4] A cold cathode lamp given in any of claim 1 whose 2nd coat is alkali metal, alkaline earth metal, or such mixture - claim 3 they are.

[Claim 5] A cold cathode lamp given in any of claim 1 which formed the 1st coat with an alkali metal compound, alkaline-earth-metal compounds, or such mixture, and formed the 2nd coat with alkali metal, alkaline earth metal, or such mixture - claim 3 they are.

[Claim 6] The cold cathode lamp according to claim 5 which formed the 1st coat with the caesium compound and formed the 2nd coat by caesium.

[Claim 7] It faces manufacturing the cold cathode lamp which prepared the electrode in the both ends of the glass tube with which the fluorescent substance layer was formed in the inner surface, and sealed the enclosure matter. The enclosure matter is sealed. one [at least] edge of said glass tube -- start-up assistance -- public funds, while arranging the electrode which has the 1st coat of a group The 2nd coat is formed in the location which does not lap with said fluorescent substance layer which energized and aged the current exceeding stationary lighting current to said electrode, carried out sputtering of said 1st coat according to this aging, and was formed in the inner surface of a glass tube. The manufacture approach of the cold cathode lamp which ends said aging in the condition that the 1st coat does not disappear from the front face of said electrode, and forms the 2nd coat in the inner surface of the 1st coat and said glass tube on the surface of an electrode.

[Claim 8] the inner surface of said arc tube [it is the cold cathode lamp which has the arc tube which prepared the electrode in the both ends of the glass tube with which the fluorescent substance layer was formed in the inner surface, and sealed the enclosure matter, and / near one / at least / electrode] -- start-up assistance -- public funds -- the cold cathode lamp which prepared the coat which consists of a group.

[Claim 9] the start-up assistance which forms said coat -- public funds -- the cold cathode lamp according to claim 8 whose group is a metal with larger spatter yield than the spatter yield by the rare gas ion of the 100-600eV range of the base metal which forms said electrode.

[Claim 10] The cold cathode lamp according to claim 8 or 9 by which the near electrode with which said coat which consists of a metal for start-up assistance at least was prepared is connected to the high-tension side of a burning circuit.

[Claim 11] A cold cathode lamp given in any of claim 8 said whose electrode is a tubed electrode - claim 10 they are.

[Claim 12] start-up assistance -- public funds -- the coat which consists of a group -- one [at least] near electrode -- and a cold cathode lamp given in any of claim 8 prepared in the inner surface of the arc tube with which the fluorescent substance layer is not formed - claim 11 they are.

[Claim 13] It faces manufacturing the cold cathode lamp which prepared the electrode in the both ends of the glass tube with which the fluorescence layer was formed in the inner surface, and sealed the enclosure matter. The electrode which has a group is prepared. one [at least] edge of said glass tube -- start-up assistance -- public funds -- said start-up assistance -- public funds -- the high current which exceeds stationary lighting current to the electrode of the side which has a group -- energizing -- aging -- this aging -- said start-up assistance -- public funds -- a group -- sputtering -- carrying out -- the inner surface of said arc tube -- start-up assistance -- public funds -- the manufacture approach of the cold cathode lamp which forms the coat which consists of a group.

[Claim 14] The manufacture approach of a cold cathode lamp according to claim 7 or 13 that an aging current is about 3 times from the twice of stationary lighting current.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] About the cold cathode lamp used for back lights, such as various liquid crystal display equipments, especially, even if this invention is the case that ambient illuminance is low, it relates to the cold cathode lamp with which the good starting characteristic is acquired.

[0002]

[Description of the Prior Art] As for the cold cathode lamp used being included in a liquid crystal device, periphery light cannot arrive at a cold cathode lamp front face easily on the structure of a liquid crystal device, and the ambient illuminance near the cold cathode lamp tends to become the bottom of a dark environment 10 luxs or less. Thus, when the cold cathode lamp was put into operation under the dark environment and the initial electron numbers in the cold cathode lamp used as the cause of discharge run short, under an original bright environment, the start up comes to take the time amount for a number - dozens of seconds to what is put into operation less than [500m second]. Generally, in the cold cathode fluorescent lamp used for a liquid crystal device, the instant start up under a dark environment 0.1 luxs or less is demanded, and it goes ahead with the talk about start up of the cold cathode lamp under such a dark environment hereafter.

[0003] In order to improve the dark starting characteristic, the cold cathode lamp

which applied the electron emitting material which becomes JP,4-121944,A from the metallic oxide of the aluminum oxide and magnesium oxide which emit an electron to the bulb inner surface near the cold cathode with the stimulus energy below a work function the inside of dark, a zinc oxide, or lead oxide is indicated.

[0004] Moreover, the cold cathode lamp which put the caesium compound on the electrode at JP,2001-15065,A, and has improved the starting characteristic is indicated.

[0005]

[Problem(s) to be Solved by the Invention] However, in the cold cathode lamp constituted as mentioned above, although an improvement is found by the dark starting characteristic, the late thing of start up is still in it. Moreover, although the starting characteristic in a dark condition was early on the average compared with that by which the cold cathode lamp which applied the electron emitting material does not apply an electron emitting material to the inner surface, the late thing of the starting characteristic was too contained in inside fairly.

[0006] This invention solves said trouble and it aims at offering the cold cathode lamp which ambient illuminance can put into operation more promptly in [dark] 0.1 luxs or less.

[0007]

[Means for Solving the Problem] the cold cathode lamp which the cold cathode lamp of this invention prepared the electrode in the both ends of the glass tube with which the fluorescent substance layer was formed in the inner surface, and sealed the enclosure matter -- it is -- an electrode -- start-up assistance -- public funds -- the 1st coat which consists of a group -- preparing -- the inner surface of a glass tube -- said 1st coat -- approaching -- start-up assistance -- public funds -- it is characterized by preparing the 2nd coat which consists of a group.

[0008] moreover, the cold cathode lamp of this invention -- an electrode -- start-up assistance -- public funds -- the ** which does not prepare the coat which consists of a group -- the inner surface of a glass tube -- start-up assistance -- public funds -- it is characterized by preparing the coat which consists of a group.

[0009] The cold cathode lamp of this invention according to claim 1 It is the cold cathode lamp which prepared the electrode in the both ends of the glass tube with which the fluorescent substance layer was formed in the inner surface, and sealed the enclosure matter. one [at least] electrode -- start-up assistance -- public funds -- the inner surface of said glass tube [the 1st coat which consists of a group is prepared and / near one / said / electrode] -- said 1st coat -- approaching -- start-up assistance -- public funds -- it is characterized by preparing the 2nd coat which consists of a group.

[0010] The cold cathode lamp of this invention according to claim 2 is characterized by forming the 2nd coat in the location which does not lap with said fluorescent substance layer formed in the inner surface of a glass tube in claim 1.

[0011] The cold cathode lamp of this invention according to claim 3 is characterized by the configuration of said electrode preparing said 1st coat in a periphery by the shape of a tube in claim 1 or claim 2.

[0012] The cold cathode lamp of this invention according to claim 4 is set they to be [any of claim 1 - claim 3], and is characterized by the 2nd coat being alkali metal, alkaline earth metal, or such mixture.

[0013] The cold cathode lamp of this invention according to claim 5 is characterized by having set they being [any of claim 1 - claim 3], having formed the 1st coat with an alkali metal compound, alkaline-earth-metal compounds, or such mixture, and forming the 2nd coat with alkali metal, alkaline earth metal, or such mixture.

[0014] The cold cathode lamp of this invention according to claim 6 is characterized by having formed the 1st coat with the caesium compound and forming the 2nd coat by caesium in claim 5.

[0015] The manufacture approach of the cold cathode lamp of this invention according to claim 7 It faces manufacturing the cold cathode lamp which prepared the electrode in the both ends of the glass tube with which the fluorescent substance layer was formed in the inner surface, and sealed the enclosure matter. The enclosure matter is sealed. one [at least] edge of said

glass tube -- start-up assistance -- public funds, while arranging the electrode which has the 1st coat of a group The 2nd coat is formed in the location which does not lap with said fluorescent substance layer which energized and aged the current exceeding stationary lighting current to said electrode, carried out sputtering of said 1st coat according to this aging, and was formed in the inner surface of a glass tube. It is characterized by ending said aging in the condition that the 1st coat does not disappear from the front face of said electrode, and forming the 2nd coat in the inner surface of the 1st coat and said glass tube on the surface of an electrode.

[0016] the inner surface of said arc tube [the cold cathode lamp of this invention according to claim 8 is a cold cathode lamp which has the arc tube which prepared the electrode in the both ends of the glass tube with which the fluorescent substance layer was formed in the inner surface, and sealed the enclosure matter, and / near one / at least / electrode] -- start-up assistance -- public funds -- it is characterized by preparing the coat which consists of a group.

[0017] the start-up assistance whose cold cathode lamp of this invention according to claim 9 forms said coat in claim 8 -- public funds -- a group is characterized by being a metal with larger spatter yield than the spatter yield by the rare gas ion of the 100-600eV range of the base metal which forms said electrode.

[0018] the cold cathode lamp of this invention according to claim 10 -- claim 8 or claim 9 -- setting -- at least -- start-up assistance -- public funds -- it is characterized by connecting to the high-tension side of a burning circuit the near electrode with which said coat which consists of a group was prepared.

[0019] The cold cathode lamp of this invention according to claim 11 is set they to be [any of claim 8 - claim 10], and is characterized by said electrode being a tubed electrode. the cold cathode lamp of this invention according to claim 12 -- or [any of claim 8 - claim 11] -- setting -- start-up assistance -- public funds -- the coat which consists of a group -- one [at least] near electrode -- and it is characterized by being prepared in the inner surface of the glass tube with which

the fluorescent substance layer is not formed.

[0020] The manufacture approach of the cold cathode lamp of this invention according to claim 13 It faces manufacturing the cold cathode lamp which prepared the electrode in the both ends of the glass tube with which the fluorescence layer was formed in the inner surface, and sealed the enclosure matter. The electrode which has a group is prepared. one [at least] edge of said glass tube -- start-up assistance -- public funds -- said start-up assistance -- public funds -- the high current which exceeds stationary lighting current to the electrode of the side which has a group -- energizing -- aging -- this aging -- said start-up assistance -- public funds -- a group -- sputtering -- carrying out -- the inner surface of said arc tube -- start-up assistance -- public funds -- it is characterized by forming the coat which consists of a group.

[0021] An aging current is characterized by the manufacture approach of the cold cathode lamp of this invention according to claim 14 being about 3 times from the twice of stationary lighting current in claim 7 or claim 13.

[0022]

[Embodiment of the Invention] Hereafter, the gestalt of each operation of this invention is explained using drawing 1 R> 1 - drawing 9 . In addition, since the structure of both ends mentioned the same thing as the example as a cold cathode lamp, only one side is shown here.

[0023] (Gestalt 1 of operation) Drawing 1 (a) and (b) show the (gestalt 1 of operation) of this invention, and drawing 1 (b) is a sectional view which meets the X-X' line in (a).

[0024] As shown in drawing 1 , the fluorescent substance layer 3 is formed in the inner surface of a glass tube 2, electrode 5a of the shape of a tube in which the edge by the side of discharge carried out opening is prepared in the both ends, a suitable quantity of the enclosure matter is sealed, and the arc tube 1 is constituted. The metal internal lead-in wire 4 is connected to the edge by the side of un-discharging [of one / at least / electrode 5a], and the external lead-in wire 7 is connected to the internal lead-in wire 4.

[0025] electrode 5a -- start-up assistance -- public funds -- the 1st coat 8 which consists of a group -- preparing -- the inner surface of a glass tube 2 -- start-up assistance -- public funds -- it is formed in the location with which the 2nd coat 9 which consists of a group does not lap in the fluorescent substance layer 3 formed in the inner surface of a glass tube 2.

[0026] The 1st coat 8 is formed with an alkali metal compound, alkaline-earth-metal compounds, or such mixture, and the 2nd coat 9 is formed with alkali metal, alkaline earth metal, or such mixture.

[0027] Hereafter, an example is given and explained. The glass tube 2 is formed in the hard material which consists of borosilicate glass, and serves as an overall length of 300mm, an outer diameter of 2.4mm, and a bore of 2.0mm. The inner surface of a glass tube 2 is covered so that a three-wave region luminescence fluorescent substance may serve as about 20 micrometers of thickness, and said fluorescent substance layer 3 is formed in it.

[0028] The internal lead-in wire 4 is formed with the tungsten which are the formation ingredient of a glass tube 2, and the ingredient which the expansion coefficient approximated. As an external lead-in wire 7, the nickel wire with an outer diameter of 0.6mm was used.

[0029] It becomes the both ends of a glass tube 2 from molybdenum, and said with outer-diameter [of 1.7mm], bore [of 1.3mm], and an overall length of 3mm - 5mm electrode 5a is prepared in them. The 1st coat 8 is formed in the electrode die-length direction covering die length of 0.5mm or more 3mm or less (preferably 1.5 **0.5mm) by the coverage of under 100microg (preferably 40**20microg) more than 10microg.

[0030] This 2nd coat 9 is formed in a predetermined location as follows. The 1st coat 8 is applied to electrode 5a. The mixed rare gas of mercury, an argon, and neon To the arc tube 1 which is enclosed by about 8 kPa(s) and formed about the 2nd coat 9 By aging by energizing a 18mA - about 25mA aging current from the twice of stationary lighting current, when the aging current which is about 3 times, for example, stationary lighting current, is 8mA During aging, sputtering is

carried out, and the 1st coat 8 applied to electrode 5a covers the inner surface of a glass tube 2, and is formed.

[0031] Aging time amount is time amount which is completed in the condition that the 1st coat 8 does not disappear from the front face of electrode 5a, and leaves the 1st coat 8 to the front face of electrode 5a and by which the 2nd coat 9 of proper thickness is formed in the inner surface of said glass tube 2, and is a 10-minute about room here.

[0032] Although sputtering of the discharge is generated and carried out even to the periphery to which the 1st coat 8 is applied from opening by the side of discharge of tube-like electrode 5a, in order that discharge may not attain to even the periphery to which the 1st coat 8 is applied for discharge of electrode 5a in stationary lighting current during aging, the 1st coat 8 and 2nd coat 9 after the completion of aging are stable, and do not disappear while in use.

[0033] thus -- beforehand -- the front face of electrode 5a -- the 1st coat 8 -- preparing -- aging -- start-up assistance -- public funds -- the thickness close to electrode 5a can form the 2nd uniform coat 9 by carrying out sputtering of the group and making the inner surface of a glass tube 2 cover.

[0034] Since according to this configuration very small discharge occurs between the 2nd coat 9 and electrode 5a or between the 2nd coat 9 and the 1st coat 8 and an initial electron required for start up is supplied in a cold cathode lamp even if it is under a dark environment, lowering of initial brightness can realize the small and good cold cathode lamp of the dark starting characteristic.

[0035] Dark start delay time with the following comparison article A was measured by using as the operation article A the cold cathode lamp constituted as mentioned above. The measurement size was made into 100. The operation article A formed the caesium compound whose 1st coat 8 is one of the alkali metal compounds, and the 2nd coat 9 by the caesium which is one of the alkali metal. That in which the 2nd coat 9 is not formed as shown in drawing 2 was used as the comparison article A.

[0036] After the test condition left the operation article A and the comparison

article A in [dark] 0.1 luxs ambient illuminance for 48 hours, it was investigated about dark start delay time using the RF burning circuit (not shown) of output voltage 1200Vrms under the ambient illuminance of 0.1 luxs, the ambient temperature of 0 degree C, and calm conditions. The obtained measurement result is shown in drawing 3 .

[0037] In the operation article A, to 90% of sample having lit up in 0.9 m seconds, the burning duration varied at 1 m seconds -, and 250 m seconds, and the lamp exceeding 500 m seconds was generated no less than 6% in the comparison article A so that clearly from this drawing 3 . In the case of the operation article A, feeble discharge occurred between the 1st coat 8 and the 2nd coat 9 or between the 2nd coat 9 and the 1st coat 8, the initial electron required for start up was supplied in the low-pressure discharge lamp, and the very good cold cathode lamp of the dark starting characteristic was obtained.

[0038] In addition, when the structure of electrode 5a of both ends is another structure, it is desirable that the near electrode with which the 1st coat 8 was formed in the front face is connected to the high-tension side of a burning circuit.

[0039] As an ingredient of the 1st coat 8, compounds of alkali metal (I group of a periodic table), such as Li, K, and Rb, can be used instead of a caesium compound. Compounds of alkaline earth metal (II group of a periodic table), such as Be, Mg, calcium, Sr, and Ba, can be used.

[0040] In addition, although the configuration of electrode 5a was a tube-like with the above-mentioned (gestalt 1 of operation), even if it was the rod-like configuration where it did not have opening in a discharge side, compared with elegance, the very good cold cathode lamp of the dark starting characteristic was obtained conventionally. However, in this case, in order to maintain the condition of the 1st and 2nd coat 8 and 9 to stability over a long period of time, it is required to restrict stationary lighting current low compared with the operation article A whose configuration of electrode 5a is a tube-like.

[0041] When comparison examination is carried out with the operation article of JP,2001-15065,A, furthermore, in the case of JP,2001-15065,A The extraneous

light which reaches the caesium compound prepared in the electrode the light which passed and decreased the luminous layer (equivalent to the fluorescent substance layer 3 in the gestalt of the above-mentioned implementation) applied inside the glass tube -- most -- it is -- the gestalt of the above-mentioned implementation of this invention -- like Compared with what carries out incidence to the 2nd coat 9, and generates very small discharge, it is the point that the good dark starting characteristic is not expectable, without forming the 2nd coat 9 in the location with which it does not lap in said fluorescent substance layer 3 formed in the inner surface of a glass tube 2, and an extraneous light decreasing it, and this invention is different from the conventional technique.

[0042] (Gestalt 2 of operation) Drawing 4 and drawing 5 show the (gestalt 2 of operation) of this invention, and drawing 4 (b) is a sectional view which meets the X-X' line in (a).

[0043] As shown in drawing 4 (a) and (b), the fluorescent substance layer 3 is formed in the inner surface of a glass tube 2, electrode 5b is prepared in the both ends, a suitable quantity of the enclosure matter is sealed, and the arc tube 1 is constituted. The metal internal lead-in wire 4 is connected to the edge by the side of un-discharging [of electrode 5b], and the external lead-in wire 7 is connected to the internal lead-in wire 4.

[0044] the inner surface of an arc tube 1 -- start-up assistance -- public funds -- coat 9a which consists of a group is formed so that it may approach with electrode 5b. Thus, in the constituted cold cathode lamp, since feeble discharge occurs between coat 9a which consists of electrode 5b and a start-up auxiliary metal and an initial electron required for start up is supplied, the very good cold cathode lamp of the dark starting characteristic is obtained.

[0045] Hereafter, an example is given and explained. The glass tube 2 is formed in the hard material which consists of borosilicate glass, and serves as an overall length of 300mm, an outer diameter of 2.4mm, and a bore of 1.8mm. The inner surface of a glass tube 2 is covered so that a three-wave region luminescence fluorescent substance may serve as about 20 micrometers of thickness, and the

fluorescent substance layer 3 is formed in it.

[0046] Electrode 5b of the shape of a rod which consists of a niobium with an overall length [of 5mm] and an outer diameter of 1.0mm is prepared in the both ends of a glass tube 2, and welded connection of the end by the side of un-discharging [of electrode 5b] is carried out to the internal lead-in wire 4 with an outer diameter of 0.8mm. The internal lead-in wire 4 is formed with the tungsten which are the formation ingredient of a glass tube 2, and the ingredient which the expansion coefficient approximated, the both ends of an arc tube 1 are closed by this internal lead-in wire 4 and glass tube 2, and the mixed rare gas (not shown) of mercury, an argon, and neon is enclosed with the interior of an arc tube 1 by about 8 kPa(s). In addition, the other end of the internal lead-in wire 4 by which the end was connected with electrode 5b is connected to the external lead-in wire 7 with an outer diameter of 0.6mm made from nickel.

[0047] Coat of 2 micrometers of thickness which consists of auxiliary metal for start up 9a is formed in the inner surface of the arc tube [/ near the electrode 5b] 1. The auxiliary metal for start up consists of a metal with larger spatter yield than the spatter yield by the rare gas ion in the 100-600eV range of the base metal of electrode 5b, and nickel with said larger spatter yield than the niobium which is the base metal of electrode 5b here is used.

[0048] This coat 9a is formed in the following procedures. Nickel with the larger spatter yield (atoms/ion) by the rare gas ion of the low energy of 100-600eV range than a niobium is put on the front face of the niobium which forms electrode 5b by methods of construction, such as electrolytic plating, electroplating, and spatter vacuum evaporationo. The thickness of nickel may be about 5 micrometers so that the thickness of coat 8a formed in the inner surface of an arc tube 1 like the after-mentioned may be set to about 2 micrometers.

[0049] The internal lead-in wire 4 is connected to the end of electrode 5b on which nickel was put on the surface of the niobium by laser welding etc., and the assembly of a cold cathode lamp is performed by the usual manufacture approach.

[0050] Drawing 5 shows the condition immediately after the assembly used as the preceding paragraph story of the cold cathode lamp shown in drawing 4 . In this condition, coat 9a is not formed in the inner surface of an arc tube 1, but the nickel which is an auxiliary metal for start up is put on the front face of electrode 5b, and forms coat 8a.

[0051] Subsequently, if the high current 6mA or more which is usual lighting current, for example, a 15mA current, energizes to this electrode 5b and aging of about 2 hours is performed to it, during aging, the nickel put on the surface of the niobium will carry out sputtering, the inner surface of the arc tube 1 close to electrode 5b will be covered, and coat 9a of about 2 micrometers of thickness will be formed.

[0052] thus -- beforehand -- the front face of electrode 5b -- start-up assistance -- public funds -- coat 8a which consists of a group -- preparing -- aging -- start-up assistance -- public funds -- the inner surface of the arc tube 1 which approached electrode 5b by carrying out sputtering of the group and making the inner surface of an arc tube 1 cover -- the start-up assistance with uniform thickness -- public funds -- coat 9a of a group can be formed in a short time, and manufacture of the good cold cathode lamp of the dark starting characteristic with small and lowering of initial brightness can be realized easily.

[0053] Dark startability was examined as follows by using as the operation article B the cold cathode lamp created as mentioned above. After the test condition left the operation article B in [dark] 0.1 luxs ambient illuminance for 48 hours, it was investigated about dark start delay time using the RF burning circuit (not shown) of output voltage 1200Vrms under the ambient illuminance of 0.1 luxs, the ambient temperature of 0 degree C, and calm conditions. The obtained measurement result is shown in drawing 9 .

[0054] Moreover, for the comparison, the lead oxide which is the electron emitting material of the metal oxide nature which emits an electron with the stimulus energy below a work function in dark was applied to the inner surface of an arc tube 1 instead of coat 9a which consists of nickel, and the cold cathode

lamp was created. It investigated about dark start delay time in the same test condition as the above by using this cold cathode lamp as the comparison article B. The measurement result of the obtained comparison article B is shown in drawing 9 .

[0055] In the operation article B and the comparison article B, although there is almost no difference in average dark start delay time, the greatest dark start delay time is 280 m seconds to 6030 m seconds of the comparison article B, and the operation article B did not have generating of big delay like the comparison article B so that clearly from drawing 9 . thus, (gestalt 2 of operation) the start-up assistance which approaches the inner surface of an arc tube 1 at electrode 5b in the operation article B which can be set -- public funds -- since feeble discharge occurred among coat 9a which consist of electrode 5b and a start-up auxiliary metal and an initial electron required for start up was supplied in a low-pressure discharge lamp by preparing coat 9a which consists of a group, the very good cold cathode lamp of the dark starting characteristic was obtained.

[0056] in addition, above-mentioned drawing 5 -- like -- start-up assistance -- public funds -- as for electrode 5a in which coat 8a which consists of a group was formed, it is desirable to connect with the high-tension side of a burning circuit. That is, although electrode 5b in which coat 8a was formed will be connected to the high-tension side of a burning circuit in the above-mentioned operation article B since the both ends of a low-pressure discharge lamp are the same structures, it is desirable that the near electrode with which the auxiliary metal for start up was prepared in the front face is connected to the high-tension side of a burning circuit for example, when the structure of both ends is another structure.

[0057] In order to check this, the cold cathode lamp which made another structure the both ends of a low-pressure discharge lamp was created, and it considered as the operation article C. start-up assistance of this operation article C -- public funds -- the near electrode with which coat 8a which consists of a group is not prepared was connected to the high-tension side of a burning circuit, and dark start delay time was measured on the same conditions as the operation

article B. The measurement size was made into 100. The obtained measurement result is shown in drawing 9 .

[0058] In the operation article C which connected to the high-tension side of a burning circuit the near electrode with which metal 8a for start-up assistance is not prepared, the dark starting characteristic is good compared with the comparison article B so that clearly from drawing 9 , and as compared with the above-mentioned operation article B, the average dark start delay time of the operation article C is large with 250 m seconds, and the greatest dark start delay time has also become 480 m seconds.

[0059] Since the electric field between the coats which consist of the near electrode and start-up auxiliary metal of distance at the time of output voltage impression of a RF burning circuit become strong, initial discharge occurs between the coats which consist of an electrode and a start-up auxiliary metal, and this is considered to be because for an initial electron required for start up to be supplied in a low-pressure discharge lamp. Thus, dark startability is remarkably improvable by connecting to the high-tension side of a burning circuit the electrode of the side which prepared the metal for start-up assistance.

[0060] In addition, although the above-mentioned explanation gave and explained the example which covered the front face of electrode 5b by coat 8a which consists of an auxiliary metal for start up, this invention is not limited to this and the auxiliary metal for start up should just be prepared in the front face of electrode 5b at least.

[0061] (Gestalt 3 of operation) Drawing 6 shows the (gestalt 3 of operation) of this invention. this (gestalt 3 of operation) -- **** -- the inner surface of the arc tube 1 which used tube-like electrode 5a instead of rod-like electrode 5b, and approached opening of electrode 5a -- start-up assistance -- public funds -- it differs from the gestalt of the above-mentioned implementation in that coat 9b which consists of a group was formed.

[0062] Electrode 5a consists of molybdenum and, specifically, has an outer diameter of 1.5mm, a bore of 1.3mm, and an overall length of 3mm. the inner

surface of the arc tube 1 close to opening of electrode 5a -- start-up assistance -- public funds -- coat of 2 micrometers of thickness which consists of nickel which is group 8b is formed.

[0063] This coat 9b forms the nickel film with a thickness of about 5 micrometers in the inner surface of electrode 5a by spatter vacuum evaporationo beforehand. By energizing the high current 6mA or more which is usual lighting current, for example, a twice to about 3 times current [15mA], to electrode 5a, and performing aging of about 2 hours During aging, the nickel vapor-deposited by the inner surface of electrode 5a covers the inner surface of the arc tube 1 which sputtering was carried out and approached opening of electrode 5a, and is formed.

[0064] Electrode 5a by which the nickel film was formed in the inner surface was connected to the high-tension side of a burning circuit by having used as the operation article D the cold cathode lamp constituted as mentioned above, and dark start delay time was measured on the same conditions as the above (gestalt 2 of operation). The measurement size was made into 100. The obtained measurement result is shown in drawing 9 .

[0065] As shown in drawing 9 , the average dark start delay time of the operation article D is 70 m seconds, the greatest dark start delay time is 150 m seconds, and it became still better from the dark starting characteristic of the operation article B in the above (gestalt 2 of operation).

[0066] By thus, the thing made for the inner surface of an arc tube 1 to put the auxiliary metal for start up prepared in the inner surface according to aging, using tube-like electrode 5a as an electrode Distance with coat 9b which consists of electrode 5a and a start-up auxiliary metal becomes still shorter than the cold cathode lamp in the above (gestalt 2 of operation). Since the electric field between electrode 5a and coat 9b become still stronger and an initial electron required for start up becomes that it is easier to be supplied, a remarkable improvement of the dark starting characteristic is realizable.

[0067] Moreover, although the coat which becomes the inner surface of electrode

5a from the auxiliary metal for start up was formed, sputtering was carried out to the inner surface of an arc tube 1 according to aging and coat 9b was formed in the above-mentioned explanation As it is not limited to this and shown in drawing 7 , this invention forms coat 8b which becomes the outside surface of electrode 5a from the auxiliary metal for start up, may carry out sputtering of this coat 8b according to aging similarly, and may form coat 9c in the inner surface of an arc tube 1. In this drawing 7 , in addition, by performing aging for about 30 minutes with a 20mA larger current than the above-mentioned explanation It becomes impossible to secure an electron number required [an electrode inner surface] for discharge. A part from the inside of electrode 5a to the outside surface near the opening A surroundings lump, [discharge] Since sputtering near the strong opening of the surroundings lump in electrode 5a becomes strong, the thickness of coat 8b and coat 9c is both thin toward the open end of electrode 5a. However, it can carry out like coat 9a which can extend discharge to the whole peripheral face of tubed electrode 5b by enlarging an aging current further, and is made to fully carry out sputtering of the coat 8b, for example, is shown in drawing 4 .

[0068] (Gestalt 4 of operation) Drawing 8 shows the (gestalt 4 of operation) of this invention. In the gestalt of this operation, it differs from the above (gestalt 3 of operation) at the point which formed 9d of coats in the inner surface of the arc tube 1 of a part with which it is near the electrode 5a, and the fluorescent substance layer 3 is not formed.

[0069] That is, unlike the cold cathode lamp which shows the cold cathode lamp in the gestalt of this operation to drawing 6 and drawing 7 , the fluorescent substance layer 3 is not installed up to the outside surface of electrode 5a, and the location which counters, but the glass tube 2 has exposed the inner surface of the arc tube 1 near the opening edge of electrode 5a, and 9d of coats which consist of an auxiliary metal for start up is formed near the opening edge of electrode 5a.

[0070] Thus, 9d of still more accurate coats is obtained rather than the coat formed in the front face at the fluorescent substance layer 3 which has the

irregularity of several microns by carrying out sputtering of the auxiliary metal for start up to the inner surface of the good glass tube 2 of surface smooth nature instead of the fluorescent substance layer 3 top directly, and forming 9d of coats.

[0071] Electrode 5a was connected to the high-tension side of a burning circuit by having used as the operation article E the cold cathode lamp constituted as mentioned above, and dark start delay time was measured on the same conditions as the above (gestalt 2 of operation). The measurement size was made into 100.

[0072] The obtained measurement result is shown in drawing 9 . As shown in drawing 9 , the average dark start delay time of the operation article E was 30 m seconds, the greatest dark start delay time was 120 m seconds, and the dark starting characteristic was still better than the operation article D in the above (gestalt 3 of operation).

[0073] In addition, although what consists of a single metal was mentioned as the example and the gestalt of each above-mentioned implementation explained it as electrodes 5a and 5b, this invention is not limited to this, can apply what consists of an alloy or a sintered metal, and can be applied to what combined the single metal, the alloy, and the sintered metal suitably further.

[0074] Moreover, although the structure of the both ends of a cold cathode lamp mentioned the same thing as the example and explained it, this invention is not limited to this and one [at least] edge should just consist of gestalten of each above-mentioned implementation as mentioned above.

[0075] Moreover, the cold cathode lamp of this invention is not limited to the gestalt of each above-mentioned implementation, and the dimension, a design, an ingredient, a form, rating, etc. can be chosen suitably. Moreover, an electrode will not be limited especially if not only an above-mentioned cylindrical electrode and an above-mentioned sleeve-like electrode but practical effectiveness, such as that in which it may be cylindrical, and the electrode of an owner bottom or a non-bottom is sufficient, for example, and the sleeve-like electrode has the structure more than two-layer, and a thing by which the emitter matter etc. is

applied to the inner surface of a sleeve-like electrode, is made.

[0076]

[Effect of the Invention] The cold cathode lamp of this invention is a cold cathode lamp which prepared the electrode in the both ends of the glass tube with which the fluorescent substance layer was formed in the inner surface, and sealed the enclosure matter as mentioned above. one [at least] electrode -- start-up assistance -- public funds -- the inner surface of said glass tube [the 1st coat which consists of a group is prepared and / near one / said / electrode] -- said 1st coat -- approaching -- start-up assistance -- public funds -- by preparing the 2nd coat which consists of a group Since feeble discharge occurs between the 1st coat and the 2nd coat which consist of a metal for start-up assistance and an initial electron required for start up is supplied in a cold cathode lamp, the dark starting characteristic is very good.

[0077] Moreover, the manufacture approach of the cold cathode lamp of this invention It faces manufacturing the cold cathode lamp which prepared the electrode in the both ends of the glass tube with which the fluorescent substance layer was formed in the inner surface, and sealed the enclosure matter. The enclosure matter is sealed. one [at least] edge of said glass tube -- start-up assistance -- public funds, while arranging the electrode which has the 1st coat of a group The 2nd coat is formed in the location which does not lap with said fluorescent substance layer which energized and aged the current exceeding stationary lighting current to said electrode, carried out sputtering of said 1st coat according to this aging, and was formed in the inner surface of a glass tube. Since said aging is ended in the condition that the 1st coat does not disappear from the front face of said electrode and the 2nd coat is formed in the inner surface of the 1st coat and said glass tube on the surface of an electrode, the cold cathode lamp of this invention is easily realizable.

[0078] Moreover, the cold cathode lamp of this invention is a cold cathode lamp which has the arc tube which prepared the electrode in the both ends of the glass tube with which the fluorescent substance layer was formed in the inner surface,

and sealed the enclosure matter. the inner surface of said arc tube [/ near one / at least / electrode] -- start-up assistance -- public funds -- by preparing the coat which consists of a group Since feeble discharge occurs in inter-electrode [which consist of a metal for start-up assistance / the coat and inter-electrode] and an initial electron required for start up is supplied in a cold cathode lamp, it becomes the very good cold cathode lamp of the dark starting characteristic.

[0079] Moreover, the manufacture approach of the cold cathode lamp of this invention It faces manufacturing the cold cathode lamp which has the arc tube which prepared the electrode in the both ends of the glass tube with which the fluorescence layer was formed in the inner surface, and sealed the enclosure matter. The electrode which has a group is prepared. one [at least] edge of said glass tube -- start-up assistance -- public funds -- said start-up assistance -- public funds -- the electrode of the side which has a group -- the high current beyond stationary lighting current -- energizing -- aging -- this aging -- said start-up assistance -- public funds -- a group -- sputtering -- carrying out -- the inner surface of said arc tube -- start-up assistance -- public funds, since the coat which consists of a group is formed The cold cathode lamp of this invention is easily realizable.

[Translation done.]

* NOTICES *

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The sectional view showing the important section of the cold cathode lamp in the (gestalt 1 of operation) of this invention, and its X-X' sectional view

[Drawing 2] The sectional view of the cold cathode lamp of the comparison article for comparing the gestalt and the starting characteristic of this operation

[Drawing 3] Burning probability-distribution drawing of the operation article of the gestalt of this operation, and a comparison article

[Drawing 4] The sectional view showing the important section of the cold cathode lamp in the (gestalt 2 of operation) of this invention, and its X-X' sectional view

[Drawing 5] the start-up assistance in the gestalt of this operation -- public funds -- the sectional view showing the important section of the cold cathode lamp before the coat of a group is formed in the inner surface of an arc tube

[Drawing 6] The sectional view showing the important section of the cold cathode lamp in the (gestalt 3 of operation) of this invention

[Drawing 7] The sectional view of an important section showing another example of the cold cathode lamp in the gestalt of this operation

[Drawing 8] The sectional view showing the important section of the cold cathode lamp in the (gestalt 4 of operation) of this invention

[Drawing 9] (Gestalt 2 of operation) Measurement result drawing of the start delay time of each operation article of - (gestalt 4 of operation), and a comparison article

[Description of Notations]

1 Arc Tube

2 Glass Tube

3 Fluorescent Substance Layer

4 Internal Lead-in Wire

5a, 5b Electrode

7 External Lead-in Wire

8 1st Coat Which Consists of a Metal for Start-Up Assistance

8a, 8b Coat which consists of a metal for start-up assistance

9 2nd Coat Which Consists of a Metal for Start-Up Assistance

9a, 9b, 9c, 9d Coat which consists of a metal for start-up assistance

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[Translation done.]

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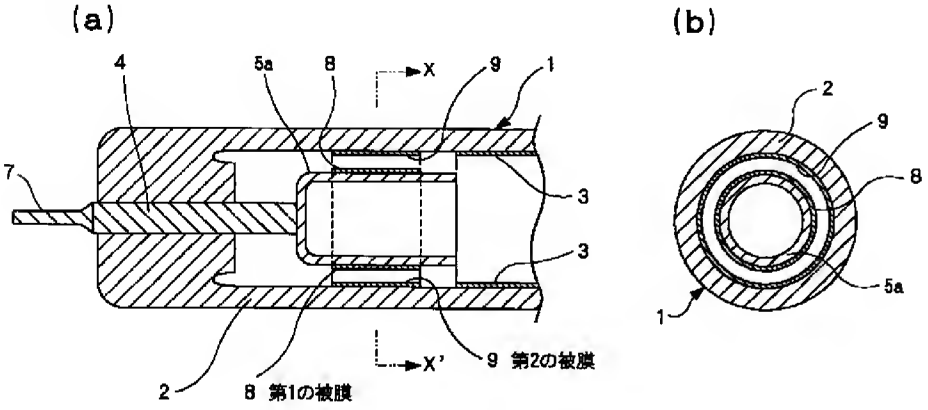
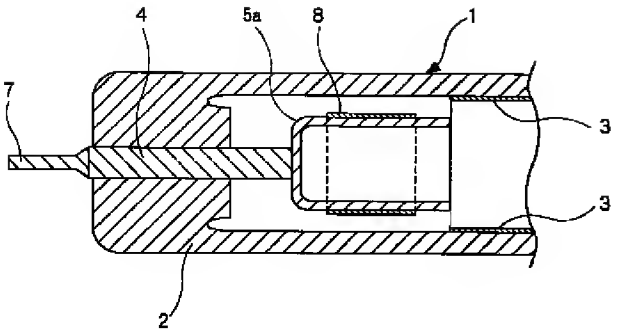
DRAWINGS

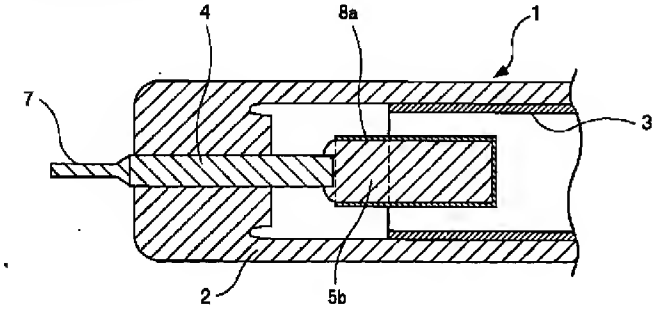
[Drawing 1]



[Drawing 2]



[Drawing 5]



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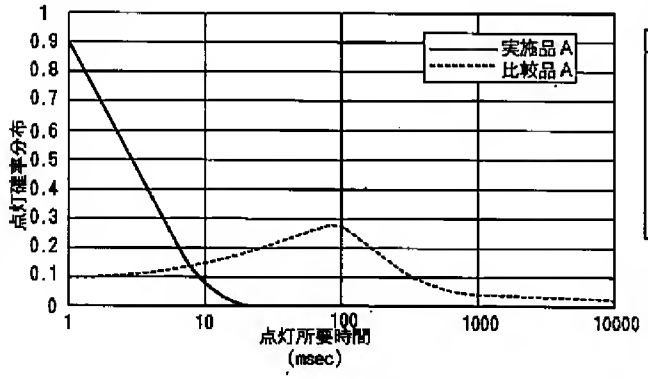
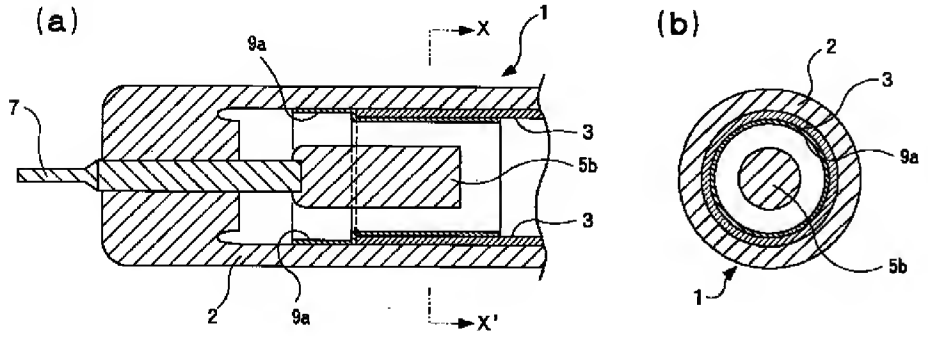


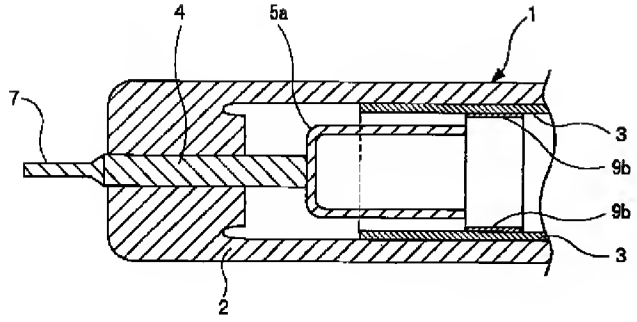
(msec)

点灯時間	実施品A	比較品A
1	0.9	0.1
10	0.08	0.14
50	0.01	0.24
100	0.01	0.27
250	0	0.13
500	0	0.06
1000	0	0.04
10000	0	0.02

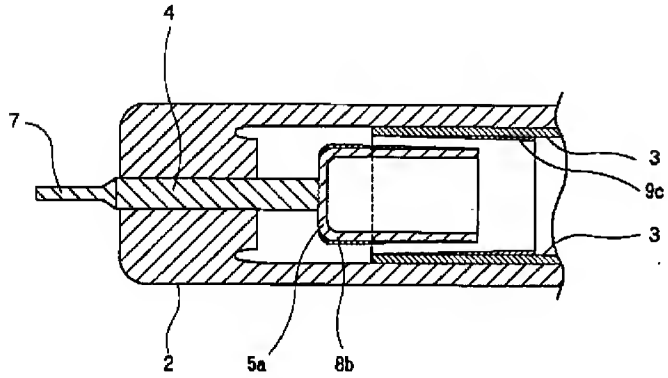
[Drawing 4]



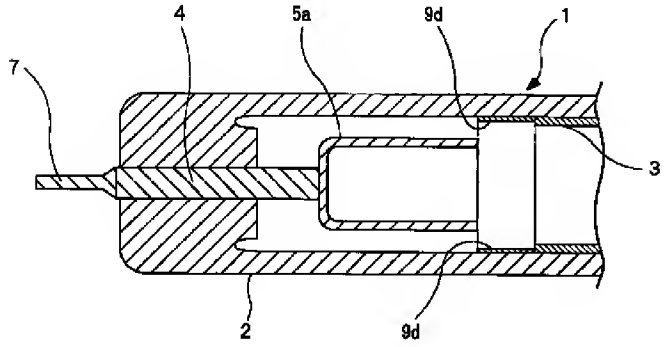
[Drawing 6]



[Drawing 7]



[Drawing 8]



[Drawing 9]

暗黒始動遅れ時間〔m秒〕	実施品B	比較品B	実施品C	実施品D	実施品E
平　均	100	115	250	70	30
最　大	280	6030	480	150	120
最　小	0	20	50	0	0

[Translation done.]

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9/44		9/44	Ｃ	５Ｃ０３９

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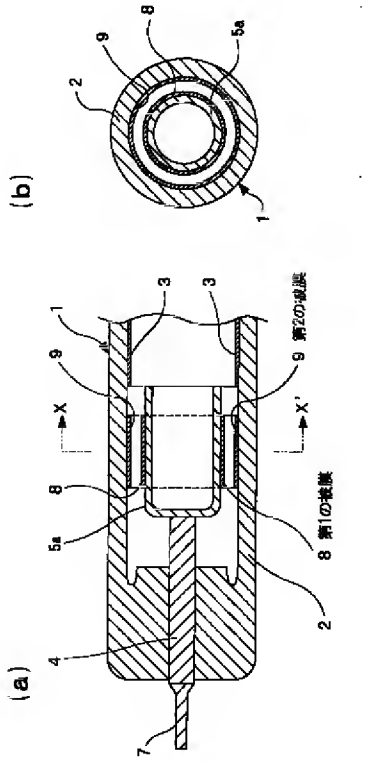
最終頁に続く

(54)【発明の名称】　冷陰極放電ランプ及びその製造方法

(57)【要約】
【課題】　周囲照度が０．１ルクス以下の暗黒中においても、速やかに始動できる冷陰極放電ランプを提供することを目的とする。
【解決手段】　内面に蛍光体層３が形成されたガラス管２の両端部に電極５ａを設け封入物質を密封した冷陰極放電ランプであって、少なくとも一方の電極５ａには始動補助用金属からなる第１の被膜８を設け、第１の被膜８に近接してガラス管２の内面に前記始動補助用金属からなる第２の被膜９を設けることによって、第２の被膜９と電極５ａの間、または第２の被膜９と第１の被膜８との間で微弱放電が発生する。



【特許請求の範囲】
【請求項１】内面に蛍光体層が形成されたガラス管の両端部に電極を設け封入物質を密封した冷陰極放電ランプであって、
少なくとも一方の電極には始動補助用金属からなる第１の被膜を設け、
前記一方の電極の近傍における前記ガラス管の内面に前記第１の被膜に近接して始動補助用金属からなる第２の被膜を設けた冷陰極放電ランプ。
【請求項２】第２の被膜を、ガラス管の内面に形成された前記蛍光体層とは重ならない位置に形成した請求項１記載の冷陰極放電ランプ。
【請求項３】前記電極の形状がチューブ状で外周に前記第１の被膜を設けた請求項１または請求項２に記載の冷陰極放電ランプ。
【請求項４】第２の被膜がアルカリ金属またはアルカリ土類金属またはこれらの混合物である請求項１～請求項３の何れかに記載の冷陰極放電ランプ。
【請求項５】第１の被膜をアルカリ金属化合物またはアルカリ土類金属化合物またはこれらの混合物で形成し、第２の被膜をアルカリ金属またはアルカリ土類金属またはこれらの混合物で形成した請求項１～請求項３の何れかに記載の冷陰極放電ランプ。
【請求項６】第１の被膜をセシウム化合物で形成し、第２の被膜をセシウムで形成した請求項５に記載の冷陰極放電ランプ。
【請求項７】内面に蛍光体層が形成されたガラス管の両端部に電極を設け封入物質を密封した冷陰極放電ランプを製造するに際し、
前記ガラス管の少なくとも一方の端部に始動補助用金属の第１の被膜を有する電極を配置するとともに封入物質を密封し、
前記電極に定常点灯電流を越える電流を通電してエージングし、このエージングにより前記第１の被膜をスパッタリングしてガラス管の内面に形成された前記蛍光体層とは重ならない位置に第２の被膜を形成し、
前記電極の表面から第１の被膜が消失しない状態で前記エージングを終了して、電極の表面に第１の被膜、前記ガラス管の内面に第２の被膜を形成する冷陰極放電ランプの製造方法。
【請求項８】内面に蛍光体層が形成されたガラス管の両端部に電極を設け封入物質を密封した発光管を有する冷陰極放電ランプであって、
少なくとも一方の電極の近傍における前記発光管の内面に始動補助用金属からなる被膜を設けた冷陰極放電ランプ。
【請求項９】前記被膜を形成する始動補助用金属が、前記電極を形成する基体金属の１００～６００ｅＶ範囲の希ガスイオンによるスパッタ収量よりもスパッタ収量の大きい金属である請求項８記載の冷陰極放電ランプ。
【請求項１０】少なくとも始動補助用金属からなる前記被膜が設けられた側の電極が点灯回路の高圧側に接続されている請求項８または請求項９記載の冷陰極放電ランプ。
【請求項１１】前記電極が筒状電極である請求項８～請求項１０の何れかに記載の冷陰極放電ランプ。
【請求項１２】始動補助用金属からなる被膜が、少なくとも一方の電極の近傍でかつ蛍光体層が形成されていない発光管の内面に設けられた請求項８～請求項１１の何れかに記載の冷陰極放電ランプ。
【請求項１３】内面に蛍光層が形成されたガラス管の両端部に電極を設け封入物質を密封した冷陰極放電ランプを製造するに際し、
前記ガラス管の少なくとも一方の端部に始動補助用金属を有する電極を設け、前記始動補助用金属を有する側の電極に定常点灯電流を越える高電流を通電してエージングし、
このエージングにより前記始動補助用金属をスパッタリングして前記発光管の内面に始動補助用金属からなる被膜を形成する冷陰極放電ランプの製造方法。
【請求項１４】エージング電流が定常点灯電流の２倍から３倍程度である請求項７または請求項１３に記載の冷陰極放電ランプの製造方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、各種液晶ディスプレイ装置等のバックライトに使用される冷陰極放電ランプに関し、特に、周囲照度が低い場合であっても良好な始動特性が得られる冷陰極放電ランプに関する。
【０００２】
【従来の技術】液晶機器に組込まれて使用される冷陰極放電ランプは、液晶機器の構造上、外周光が冷陰極放電ランプ表面に到達し難く、冷陰極放電ランプ近傍の周囲照度は１０ルクス以下の暗い環境下となり易い。このように暗い環境下で冷陰極放電ランプを始動すると、放電のきっかけとなる冷陰極放電ランプ中の初期電子数が不足した場合に、本来の明るい環境下では５００ｍ秒以内に始動するものが、その始動に数～数十秒の時間を要するようになる。一般に、液晶機器に使用される冷陰極蛍光ランプでは、０．１ルクス以下の暗い環境下での即時始動が要望されており、以下、このような暗い環境下における冷陰極放電ランプの始動について話を進める。
【０００３】暗黒始動特性を改善するために、特開平４－１２１９４４号公報には、冷陰極近傍のバルブ内面に、暗黒中において仕事関数以下の刺激エネルギーで電子を放出する、酸化アルミニウム、酸化マグネシウム、酸化亜鉛、酸化鉛等のいずれかの金属酸化物からなる電子放射物質を塗布した冷陰極放電ランプが開示されている。
【０００４】また、特開２００１－１５０６５号公報に

は電極にセシウム化合物を被着して始動特性を改善した冷陰極放電ランプが開示されている。

【０００５】

【発明が解決しようとする課題】しかしながら、上記のように構成された冷陰極放電ランプでは、その暗黒始動特性に改善は見られるものの依然として始動の遅いものがある。また、電子放射物質を塗布した冷陰極放電ランプは、その内面に電子放射物質を塗布しないものに比べて暗黒状態での始動特性は平均的に早いものの、やはり中には相当に始動特性の遅いものが含まれていた。

【０００６】本発明は前記問題点を解決し、周囲照度が０．１ルクス以下の暗黒中においても、より速やかに始動できる冷陰極放電ランプを提供することを目的とする。

【０００７】

【課題を解決するための手段】本発明の冷陰極放電ランプは、内面に蛍光体層が形成されたガラス管の両端部に電極を設け封入物質を密封した冷陰極放電ランプであって、電極に始動補助用金属からなる第１の被膜を設け、ガラス管の内面に前記第１の被膜に近接して始動補助用金属からなる第２の被膜を設けたことを特徴とする。

【０００８】また、本発明の冷陰極放電ランプは、電極には始動補助用金属からなる被膜を設けずに、ガラス管の内面にだけ始動補助用金属からなる被膜を設けたことを特徴とする。

【０００９】本発明の請求項１記載の冷陰極放電ランプは、内面に蛍光体層が形成されたガラス管の両端部に電極を設け封入物質を密封した冷陰極放電ランプであって、少なくとも一方の電極には始動補助用金属からなる第１の被膜を設け、前記一方の電極の近傍における前記ガラス管の内面に前記第１の被膜に近接して始動補助用金属からなる第２の被膜を設けたことを特徴とする。

【００１０】本発明の請求項２記載の冷陰極放電ランプは、請求項１において、第２の被膜を、ガラス管の内面に形成された前記蛍光体層とは重ならない位置に形成したことを特徴とする。

【００１１】本発明の請求項３記載の冷陰極放電ランプは、請求項１または請求項２において、前記電極の形状がチューブ状で外周に前記第１の被膜を設けたことを特徴とする。

【００１２】本発明の請求項４記載の冷陰極放電ランプは、請求項１～請求項３の何れかにおいて、第２の被膜がアルカリ金属またはアルカリ土類金属またはこれらの混合物であることを特徴とする。

【００１３】本発明の請求項５記載の冷陰極放電ランプは、請求項１～請求項３の何れかにおいて、第１の被膜をアルカリ金属化合物またはアルカリ土類金属化合物またはこれらの混合物で形成し、第２の被膜をアルカリ金属またはアルカリ土類金属またはこれらの混合物で形成したことを特徴とする。

【００１４】本発明の請求項６記載の冷陰極放電ランプは、請求項５において、第１の被膜をセシウム化合物で形成し、第２の被膜をセシウムで形成したことを特徴とする。

【００１５】本発明の請求項７記載の冷陰極放電ランプの製造方法は、内面に蛍光体層が形成されたガラス管の両端部に電極を設け封入物質を密封した冷陰極放電ランプを製造するに際し、前記ガラス管の少なくとも一方の端部に始動補助用金属の第１の被膜を有する電極を配置するとともに封入物質を密封し、前記電極に定常点灯電流を越える電流を通電してエージングし、このエージングにより前記第１の被膜をスパッタリングしてガラス管の内面に形成された前記蛍光体層とは重ならない位置に第２の被膜を形成し、前記電極の表面から第１の被膜が消失しない状態で前記エージングを終了して、電極の表面に第１の被膜、前記ガラス管の内面に第２の被膜を形成することを特徴とする。

【００１６】本発明の請求項８記載の冷陰極放電ランプは、内面に蛍光体層が形成されたガラス管の両端部に電極を設け封入物質を密封した発光管を有する冷陰極放電ランプであって、少なくとも一方の電極の近傍における前記発光管の内面に始動補助用金属からなる被膜を設けたことを特徴とする。

【００１７】本発明の請求項９記載の冷陰極放電ランプは、請求項８において、前記被膜を形成する始動補助用金属が、前記電極を形成する基体金属の１００～６００ｅＶ範囲の希ガスイオンによるスパッタ収量よりもスパッタ収量の大きい金属であることを特徴とする。

【００１８】本発明の請求項１０記載の冷陰極放電ランプは、請求項８または請求項９において、少なくとも始動補助用金属からなる前記被膜が設けられた側の電極が点灯回路の高圧側に接続されていることを特徴とする。

【００１９】本発明の請求項１１記載の冷陰極放電ランプは、請求項８～請求項１０の何れかにおいて、前記電極が筒状電極であることを特徴とする。本発明の請求項１２記載の冷陰極放電ランプは、請求項８～請求項１１の何れかにおいて、始動補助用金属からなる被膜が、少なくとも一方の電極の近傍でかつ蛍光体層が形成されていないガラス管の内面に設けられたことを特徴とする。

【００２０】本発明の請求項１３記載の冷陰極放電ランプの製造方法は、内面に蛍光層が形成されたガラス管の両端部に電極を設け封入物質を密封した冷陰極放電ランプを製造するに際し、前記ガラス管の少なくとも一方の端部に始動補助用金属を有する電極を設け、前記始動補助用金属を有する側の電極に定常点灯電流を越える高電流を通電してエージングし、このエージングにより前記始動補助用金属をスパッタリングして前記発光管の内面に始動補助用金属からなる被膜を形成することを特徴とする。

【００２１】本発明の請求項１４記載の冷陰極放電ラン

プの製造方法は、請求項７または請求項１３において、エージング電流が定常点灯電流の２倍から３倍程度であることを特徴とする。

【００２２】

【発明の実施の形態】以下、本発明の各実施の形態を図１～図９を用いて説明する。なお、ここでは、冷陰極放電ランプとして両端部の構造が同一であるものを例に挙げたため、一方の側のみ示している。

【００２３】（実施の形態１）図１（ａ）（ｂ）は本発明の（実施の形態１）を示し、図１（ｂ）は（ａ）におけるＸ－Ｘ′線に沿う断面図である。

【００２４】図１に示すように、ガラス管２の内面には蛍光体層３が形成されており、その両端部には放電側の端部が開口したチューブ状の電極５ａが設けられ、適切な量の封入物質が密封されて発光管１が構成されている。少なくとも一方の電極５ａの非放電側の端部には金属製の内部導入線４が接続されており、内部導入線４には外部導入線７が接続されている。

【００２５】電極５ａには始動補助用金属からなる第１の被膜８を設け、ガラス管２の内面には、始動補助用金属からなる第２の被膜９が、ガラス管２の内面に形成された蛍光体層３とは重ならない位置に形成されている。

【００２６】第１の被膜８はアルカリ金属化合物またはアルカリ土類金属化合物またはこれらの混合物で形成されており、第２の被膜９はアルカリ金属またはアルカリ土類金属またはこれらの混合物で形成されている。

【００２７】以下、具体例を挙げて説明する。ガラス管２は、ホウケイ酸ガラスからなる硬質材にて形成されており、全長３００ｍｍ、外径２．４ｍｍ、内径２．０ｍｍとなっている。ガラス管２の内面には、三波長域発光蛍光体が膜厚２０μｍ程度となるように被着されて前記蛍光体層３が形成されている。

【００２８】内部導入線４はガラス管２の形成材料と膨張係数が近似した材料であるタングステンにて形成されている。外部導入線７としては外径０．６ｍｍのニッケル線を使用した。

【００２９】ガラス管２の両端部には、モリブデンからなり、外径１．７ｍｍ、内径１．３ｍｍ、全長３ｍｍ～５ｍｍの前記電極５ａが設けられている。第１の被膜８は、１０μｇ以上１００μｇ未満（好ましくは、４０±２０μｇ）の塗布量で電極長さ方向に０．５ｍｍ以上３ｍｍ以下（好ましくは、１．５±０．５ｍｍ）の長さにわたって形成されている。

【００３０】この第２の被膜９は、次のようにして所定位置に形成される。第１の被膜８が電極５ａに塗布され、水銀とアルゴンとネオンとの混合希ガスが、約８ｋＰａで封入され、第２の被膜９については設けられていない発光管１に、定常点灯電流の２倍から３倍程度であるエージング電流、例えば、定常点灯電流が８ｍＡの場合には１８ｍＡ～２５ｍＡ程度のエージング電流を通電してエージングを行うことで、エージング中に電極５ａに塗布された第１の被膜８がスパッタリングしてガラス管２の内面に被着して形成される。

【００３１】ここでエージング時間は、電極５ａの表面から第１の被膜８が消失しない状態で終了して電極５ａの表面に第１の被膜８を残して、前記ガラス管２の内面に適正な膜厚の第２の被膜９が形成される時間であって、１０分間程度である。

【００３２】エージング中には放電がチューブ状の電極５ａの放電側の開口から第１の被膜８が塗布されている外周にまで放電が発生してスパッタリングされるが、定常点灯電流では電極５ａの放電が第１の被膜８が塗布されている外周にまで及ばないため、エージング完了後の第１の被膜８と第２の被膜９は安定していて使用中に消失しない。

【００３３】このように、あらかじめ電極５ａの表面に第１の被膜８を設け、エージングにより始動補助用金属をスパッタリングしてガラス管２の内面に被着させることで、電極５ａに近接した膜厚が均一な第２の被膜９を形成することができる。

【００３４】この構成によると、暗黒の環境下であっても第２の被膜９と電極５ａの間、または第２の被膜９と第１の被膜８との間で微少放電が発生し、冷陰極放電ランプ内に始動に必要な初期電子が供給されるので、初期輝度の低下が小さくかつ暗黒始動特性の良好な冷陰極放電ランプを実現できる。

【００３５】上記のように構成された冷陰極放電ランプを実施品Ａとして、下記の比較品Ａとの暗黒始動遅れ時間を測定した。サンプル数は１００本とした。実施品Ａは第１の被膜８はアルカリ金属化合物の１つであるセシウム化合物、第２の被膜９はアルカリ金属の１つであるセシウムで形成した。図２に示すように第２の被膜９が形成されていないものを比較品Ａとした。

【００３６】テスト条件は、実施品Ａと比較品Ａを周囲照度０．１ルクスの暗黒中に４８時間放置した後、周囲照度０．１ルクス、周囲温度０℃、無風の条件下で出力電圧１２００Ｖｒｍｓの高周波点灯回路（図示せず）を用いて、暗黒始動遅れ時間について調べた。得られた測定結果を図３に示す。

【００３７】この図３から明らかなように、実施品Ａでは９０％のサンプルが０．９ｍ秒で点灯したのに対して、比較品Ａでは点灯所要時間が１ｍ秒～２５０ｍ秒にばらついて、５００ｍ秒を越えるランプが６％も発生した。実施品Ａの場合には、第１の被膜８と第２の被膜９の間、または第２の被膜９と第１の被膜８との間で微弱放電が発生して低圧放電ランプ内に始動に必要な初期電子が供給され、暗黒始動特性の極めて良好な冷陰極放電ランプが得られた。

【００３８】なお、両端部の電極５ａの構造が別構造である場合には、その表面に第１の被膜８が形成された側

の電極が、点灯回路の高圧側に接続されていることが好ましい。

【００３９】第１の被膜８の材料としては、アルカリ金属（周期表のＩ族）のＬｉ，Ｋ，Ｒｂなどの化合物をセシウム化合物に代わって使用することができる。アルカリ土類金属（周期表のII族）のＢｅ，Ｍｇ，Ｃａ，Ｓｒ，Ｂａなどの化合物を使用できる。

【００４０】なお、上記の（実施の形態１）では電極５ａの形状がチューブ状であったが、放電側に開口を有していない棒状の形状であっても、従来品に比べて暗黒始動特性の極めて良好な冷陰極放電ランプが得られた。但しこの場合には、長期間にわたって第１，第２の被膜８，９の状態を安定に維持するために、定常点灯電流を電極５ａの形状がチューブ状である実施品Ａに比べて低く制限することが必要である。

【００４１】さらに、特開２００１－１５０６５号公報の実施品と比較検討すると、特開２００１－１５０６５号公報の場合には、電極に設けられたセシウム化合物に届く外部光は、ガラス管の内側に塗布された発光層（上記実施の形態における蛍光体層３に相当）を通過して減衰した光がほとんどであって、本発明の上記実施の形態ように、第２の被膜９を、ガラス管２の内面に形成された前記蛍光体層３とは重ならない位置に形成し、外部光が減衰することなく第２の被膜９に入射して微少放電を発生するものに比べて、良好な暗黒始動特性を期待できない点で、本発明は従来技術とは相違している。

【００４２】（実施の形態２）図４と図５は、本発明の（実施の形態２）を示し、図４（ｂ）は（ａ）におけるＸ－Ｘ′線に沿う断面図である。

【００４３】図４（ａ）（ｂ）に示すように、ガラス管２の内面には蛍光体層３が形成されており、その両端部には電極５ｂが設けられ、適切な量の封入物質が密封されて発光管１が構成されている。電極５ｂの非放電側の端部には金属製の内部導入線４が接続されており、内部導入線４には外部導入線７が接続されている。

【００４４】発光管１の内面には、始動補助用金属からなる被膜９ａが、電極５ｂと近接するように形成されている。このように構成された冷陰極放電ランプでは、電極５ｂと始動補助金属からなる被膜９ａとの間で微弱放電が発生して始動に必要な初期電子が供給されるため、暗黒始動特性の極めて良好な冷陰極放電ランプが得られる。

【００４５】以下、具体例を挙げて説明する。ガラス管２は、ホウケイ酸ガラスからなる硬質材にて形成されており、全長３００ｍｍ、外径２．４ｍｍ、内径１．８ｍｍとなっている。ガラス管２の内面には、三波長域発光蛍光体が膜厚２０μｍ程度となるように被着されて、蛍光体層３が形成されている。

【００４６】ガラス管２の両端部には、全長５ｍｍ、外径１．０ｍｍのニオビウムからなる棒状の電極５ｂが設けられており、電極５ｂの非放電側の一端は、外径０．８ｍｍの内部導入線４と溶接接続されている。内部導入線４はガラス管２の形成材料と膨張係数が近似した材料であるタングステンにて形成されており、この内部導入線４とガラス管２とにより発光管１の両端部は封止され、発光管１の内部には水銀とアルゴンとネオンとの混合希ガス（図示せず）が、約８ｋＰａで封入されている。なお、一端が電極５ｂと接続された内部導入線４の他端は、外径０．６ｍｍのニッケル製の外部導入線７に接続されている。

【００４７】電極５ｂの近傍における発光管１の内面には、始動用補助金属からなる膜厚２μｍの被膜９ａが形成されている。始動用補助金属は、電極５ｂの基体金属の１００～６００ｅＶ範囲での希ガスイオンによるスパッタ収量よりもスパッタ収量の大きい金属からなり、ここでは電極５ｂの基体金属であるニオビウムよりも前記スパッタ収量の大きいニッケルが使用されている。

【００４８】この被膜９ａは、以下の手順にて形成される。電極５ｂを形成するニオビウムの表面に、１００～６００ｅＶ範囲の低エネルギーの希ガスイオンによるスパッタ収量（ａｔｏｍｓ／ｉｏｎ）がニオビウムよりも大きいニッケルが、電解メッキ、電気メッキ、スパッタ蒸着等の工法により被着される。ニッケルの膜厚は、後述のように発光管１の内面に形成される被膜８ａの膜厚が２μｍ程度となるように、５μｍ程度とする。

【００４９】ニオビウムの表面にニッケルが被着された電極５ｂの一端に、内部導入線４がレーザ溶接等により接続され、通常の製造方法により冷陰極放電ランプの組み立てが行われる。

【００５０】図５は図４に示す冷陰極放電ランプの前段階となる組み立て直後の状態を示す。この状態では、発光管１の内面に被膜９ａは形成されておらず、始動用補助金属であるニッケルは電極５ｂの表面に被着され被膜８ａを形成している。

【００５１】次いで、この電極５ｂに通常の点灯電流である６ｍＡ以上の高電流、例えば１５ｍＡの電流が通電され約２時間のエージングが行われると、エージング中にニオビウムの表面に被着したニッケルがスパッタリングして、電極５ｂに近接した発光管１の内面に被着し、膜厚２μｍ程度の被膜９ａが形成される。

【００５２】このようにあらかじめ電極５ｂの表面に始動補助用金属からなる被膜８ａを設け、エージングにより始動補助用金属をスパッタリングして発光管１の内面に被着させることで、電極５ｂに近接した発光管１の内面へ膜厚が均一な始動補助用金属の被膜９ａを短時間で形成でき、初期輝度の低下が小さくかつ暗黒始動特性の良好な冷陰極放電ランプの製造が容易に実現できる。

【００５３】上記のように作成した冷陰極放電ランプを実施品Ｂとして、下記のように暗黒始動性について検討した。テスト条件は、実施品Ｂを周囲照度０．１ルクス

の暗黒中に４８時間放置した後、周囲照度０．１ルクス、周囲温度０℃、無風の条件下で出力電圧１２００Ｖｒｍｓの高周波点灯回路（図示せず）を用いて、暗黒始動遅れ時間について調べた。得られた測定結果を図９に示す。

【００５４】また、比較のために、ニッケルからなる被膜９ａの代わりに、暗黒中で仕事関数以下の刺激エネルギーで電子を放出する酸化金属性の電子放射物質である酸化鉛を発光管１の内面に塗布して冷陰極放電ランプを作成した。この冷陰極放電ランプを比較品Ｂとして上記と同様のテスト条件にて暗黒始動遅れ時間について調べた。得られた比較品Ｂの測定結果を図９に示す。

【００５５】図９から明らかなように、実施品Ｂと比較品Ｂとでは、平均の暗黒始動遅れ時間にはほとんど差は無いものの、最大の暗黒始動遅れ時間は比較品Ｂの６０３０ｍ秒に対して実施品Ｂは２８０ｍ秒であり、比較品Ｂのように大きな遅れの発生は無かった。このように（実施の形態２）における実施品Ｂでは、発光管１の内面に電極５ｂに近接する始動補助用金属よりなる被膜９ａを設けることで、電極５ｂと始動補助金属よりなる被膜９ａ間で微弱放電が発生して低圧放電ランプ内に始動に必要な初期電子が供給されるため、暗黒始動特性の極めて良好な冷陰極放電ランプが得られた。

【００５６】なお、上記図５のように、始動補助用金属からなる被膜８ａが形成された電極５ａは、点灯回路の高圧側に接続されていることが好ましい。すなわち、上記の実施品Ｂでは低圧放電ランプの両端部が同一構造であるため被膜８ａが形成された電極５ｂが点灯回路の高圧側に接続されることとなるが、例えば、両端部の構造が別構造である場合には、その表面に始動用補助金属が設けられた側の電極が、点灯回路の高圧側に接続されていることが好ましい。

【００５７】このことを確認するために、低圧放電ランプの両端部を別構造とした冷陰極放電ランプを作成し、実施品Ｃとした。この実施品Ｃの始動補助用金属からなる被膜８ａが設けられていない側の電極を点灯回路の高圧側に接続し、実施品Ｂと同じ条件にて暗黒始動遅れ時間を測定した。サンプル数は１００本とした。得られた測定結果を図９に示す。

【００５８】図９から明らかなように、始動補助用金属８ａが設けられていない側の電極を点灯回路の高圧側に接続した実施品Ｃにおいても比較品Ｂに比べて暗黒始動特性は良好となっているが、上記の実施品Ｂと比較すると、実施品Ｃの平均暗黒始動遅れ時間は２５０ｍ秒と大きくなっており、最大の暗黒始動遅れ時間も４８０ｍ秒となっている。

【００５９】これは、高周波点灯回路の出力電圧印加時に、距離の近い電極と始動補助金属よりなる被膜間の電界が強くなるので、電極と始動補助金属よりなる被膜間で初期放電が発生し、低圧放電ランプ内に始動に必要な初期電子が供給されるためであると考えられる。このように、始動補助用金属を設けた側の電極を点灯回路の高圧側に接続することで、暗黒始動性を著しく改善できる。

【００６０】なお、上記説明では、電極５ｂの表面を始動用補助金属からなる被膜８ａで覆った例を挙げて説明したが、本発明はこれに限定されるものではなく、少なくとも電極５ｂの表面に始動用補助金属が設けられていればよい。

【００６１】（実施の形態３）図６は、本発明の（実施の形態３）を示す。この（実施の形態３）では、棒状の電極５ｂの代わりにチューブ状の電極５ａを用い、電極５ａの開口部に近接した発光管１の内面に始動補助用金属よりなる被膜９ｂを形成した点で上記実施の形態とは異なる。

【００６２】具体的には、電極５ａはモリブデンからなり、外径１．５ｍｍ、内径１．３ｍｍ、全長３ｍｍとなっている。電極５ａの開口部に近接した発光管１の内面には、始動補助用金属であるニッケルよりなる膜厚２μｍの被膜８ｂが形成されている。

【００６３】この被膜９ｂは、電極５ａの内面に予めスパッタ蒸着により厚み５μｍ程度のニッケル膜を形成し、通常の点灯電流である６ｍＡ以上の高電流、例えば２倍から３倍程度の１５ｍＡの電流を電極５ａに通電して約２時間のエージングを行うことで、エージング中に電極５ａの内面に蒸着されたニッケルがスパッタリングされて電極５ａの開口部に近接した発光管１の内面に被着して形成される。

【００６４】上記のように構成された冷陰極放電ランプを実施品Ｄとして、その内面にニッケル膜が形成された電極５ａを点灯回路の高圧側に接続し、上記（実施の形態２）と同じ条件にて暗黒始動遅れ時間を測定した。サンプル数は１００本とした。得られた測定結果を図９に示す。

【００６５】図９に示すように、実施品Ｄの平均暗黒始動遅れ時間は７０ｍ秒、最大の暗黒始動遅れ時間は１５０ｍ秒であり、上記（実施の形態２）における実施品Ｂの暗黒始動特性よりもさらに良いものとなった。

【００６６】このように電極としてチューブ状の電極５ａを用い、その内面に設けた始動用補助金属をエージングにより発光管１の内面に被着させることで、電極５ａと始動補助金属よりなる被膜９ｂとの距離が上記（実施の形態２）における冷陰極放電ランプよりも更に短くなり、電極５ａと被膜９ｂとの間の電界が更に強くなって始動に必要な初期電子がより供給されやすくなるため、暗黒始動特性の著しい改善が実現できる。

【００６７】また、上記説明では、電極５ａの内面に始動用補助金属からなる被膜を形成してエージングにより発光管１の内面にスパッタリングさせて被膜９ｂを形成したが、本発明はこれに限定されるものではなく、図７

に示すように、電極５ａの外表面に始動用補助金属からなる被膜８ｂを形成し、この被膜８ｂを同様にエージングによりスパッタリングして発光管１の内面に被膜９ｃを形成してもよい。なお、この図７では、約３０分間のエージングを上記説明よりも大きい２０ｍＡの電流で行うことにより、電極内面だけでは放電に必要な電子数が確保できなくなり、放電が電極５ａの内側から開口部の近傍の外表面に一部が回り込み、電極５ａにおける回り込みの強い開口部の近傍のスパッタリングが強くなるので被膜８ｂと被膜９ｃの厚みがともに電極５ａの開放端に向かって薄くなっている。しかしながら、更にエージング電流を大きくすることで放電を筒状電極５ｂの外周面全体に広げることができ、被膜８ｂを十分にスパッタリングさせて、例えば図４に示す被膜９ａのようにすることができる。

【００６８】（実施の形態４）図８は本発明の（実施の形態４）を示す。この実施の形態では、被膜９ｄを電極５ａの近傍でかつ蛍光体層３が形成されていない部分の発光管１の内面に形成した点で上記（実施の形態３）とは異なる。

【００６９】すなわち、この実施の形態における冷陰極放電ランプは、図６，図７に示す冷陰極放電ランプとは異なり、蛍光体層３は電極５ａの外面と対向する位置までは延設されておらず、電極５ａの開口端付近の発光管１の内面はガラス管２が露出しており、電極５ａの開口端付近には始動用補助金属からなる被膜９ｄが形成されている。

【００７０】このように蛍光体層３の上ではなく、表面平滑性の良いガラス管２の内面に、直接に始動用補助金属をスパッタリングさせて被膜９ｄを形成することで、表面に数ミクロンの凹凸を有する蛍光体層３に形成した被膜よりもさらに精度の良い被膜９ｄが得られる。

【００７１】上記のように構成された冷陰極放電ランプを実施品Ｅとして、電極５ａを点灯回路の高圧側に接続し、上記（実施の形態２）と同じ条件にて暗黒始動遅れ時間を測定した。サンプル数は１００本とした。

【００７２】得られた測定結果を図９に示す。図９に示すように、実施品Ｅの平均暗黒始動遅れ時間は３０ｍ秒、最大の暗黒始動遅れ時間は１２０ｍ秒であり、上記（実施の形態３）における実施品Ｄよりもさらに暗黒始動特性の良いものであった。

【００７３】なお、上記各実施の形態では、電極５ａ，５ｂとして、単一金属からなるものを例に挙げて説明したが、本発明はこれに限定されるものではなく、合金や焼結金属からなるものも適用でき、さらに単一金属、合金、焼結金属を適宜組み合わせたものなどにも適用可能である。

【００７４】また、上記各実施の形態では、冷陰極放電ランプの両端部の構造が同じものを例に挙げて説明したが、本発明はこれに限定されるものではなく、少なくとも一方の端部が上記のように構成されていればよい。

【００７５】また、本発明の冷陰極放電ランプは、上記各実施の形態に限定されるものではなく、その寸法、設計、材料、形、定格等は適宜選択が可能である。また、電極は、上記の棒状電極やスリーブ状電極だけでなく、例えば円筒状で有底あるいは無底の電極でもよく、またスリーブ状電極が２層以上の構造を有しているものや、スリーブ状電極の内面にエミッタ物質等が塗布されているものなど、実用上の効果をなすものであれば特に限定されるものではない。

【００７６】

【発明の効果】以上のように本発明の冷陰極放電ランプは、内面に蛍光体層が形成されたガラス管の両端部に電極を設け封入物質を密封した冷陰極放電ランプであって、少なくとも一方の電極には始動補助用金属からなる第１の被膜を設け、前記一方の電極の近傍における前記ガラス管の内面に前記第１の被膜に近接して始動補助用金属からなる第２の被膜を設けることで、始動補助用金属よりなる第１の被膜と第２の被膜の間で微弱放電が発生して冷陰極放電ランプ内に始動に必要な初期電子が供給されるため、暗黒始動特性が極めて良好である。

【００７７】また、本発明の冷陰極放電ランプの製造方法は、内面に蛍光体層が形成されたガラス管の両端部に電極を設け封入物質を密封した冷陰極放電ランプを製造するに際し、前記ガラス管の少なくとも一方の端部に始動補助用金属の第１の被膜を有する電極を配置するとともに封入物質を密封し、前記電極に定常点灯電流を越える電流を通電してエージングし、このエージングにより前記第１の被膜をスパッタリングしてガラス管の内面に形成された前記蛍光体層とは重ならない位置に第２の被膜を形成し、前記電極の表面から第１の被膜が消失しない状態で前記エージングを終了して、電極の表面に第１の被膜、前記ガラス管の内面に第２の被膜を形成するので、本発明の冷陰極放電ランプを容易に実現できる。

【００７８】また、本発明の冷陰極放電ランプは、内面に蛍光体層が形成されたガラス管の両端部に電極を設け封入物質を密封した発光管を有する冷陰極放電ランプであって、少なくとも一方の電極の近傍における前記発光管の内面に始動補助用金属からなる被膜を設けることで、始動補助用金属よりなる被膜と電極間で微弱放電が発生して冷陰極放電ランプ内に始動に必要な初期電子が供給されるため、暗黒始動特性の極めて良好な冷陰極放電ランプとなる。

【００７９】また、本発明の冷陰極放電ランプの製造方法は、内面に蛍光層が形成されたガラス管の両端部に電極を設け封入物質を密封した発光管を有する冷陰極放電ランプを製造するに際し、前記ガラス管の少なくとも一方の端部に始動補助用金属を有する電極を設け、前記始動補助用金属を有する側の電極に定常点灯電流以上の高電流を通電してエージングし、このエージングにより前

記始動補助用金属をスパッタリングして前記発光管の内面に始動補助用金属からなる被膜を形成するので、本発明の冷陰極放電ランプを容易に実現できる。

【図面の簡単な説明】

【図１】本発明の（実施の形態１）における冷陰極放電ランプの要部を示す断面図とそのＸ－Ｘ′断面図

【図２】同実施の形態と始動特性を比較するための比較品の冷陰極放電ランプの断面図

【図３】同実施の形態の実施品と比較品との点灯確率分布図

【図４】本発明の（実施の形態２）における冷陰極放電ランプの要部を示す断面図とそのＸ－Ｘ′断面図

【図５】同実施の形態における始動補助用金属の被膜が発光管の内面に形成される前の冷陰極放電ランプの要部を示す断面図

【図６】本発明の（実施の形態３）における冷陰極放電ランプの要部を示す断面図

【図７】同実施の形態における冷陰極放電ランプの別の例を示す要部の断面図

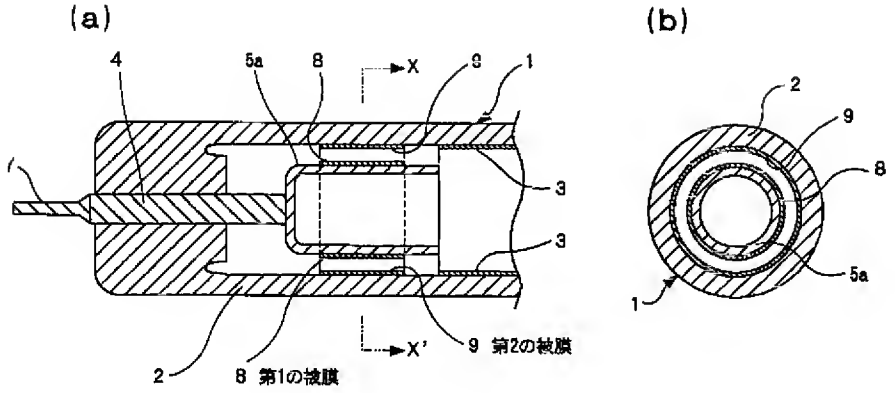
【図８】本発明の（実施の形態４）における冷陰極放電ランプの要部を示す断面図

【図９】（実施の形態２）～（実施の形態４）の各実施品と比較品の始動遅れ時間の測定結果図

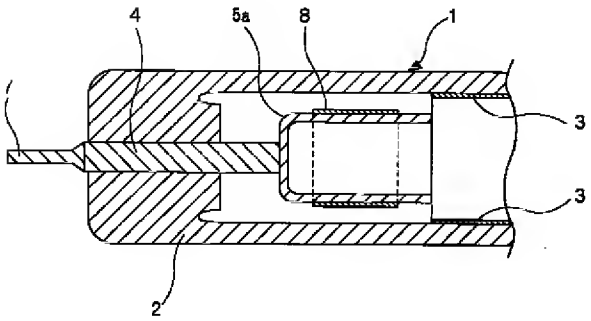
【符号の説明】

１　発光管
２　ガラス管
３　蛍光体層
４　内部導入線
５ａ，５ｂ　電極
７　外部導入線
８　始動補助用金属からなる第１の被膜
８ａ，８ｂ　始動補助用金属からなる被膜
９　始動補助用金属からなる第２の被膜
９ａ，９ｂ，９ｃ，９ｄ　始動補助用金属からなる被膜

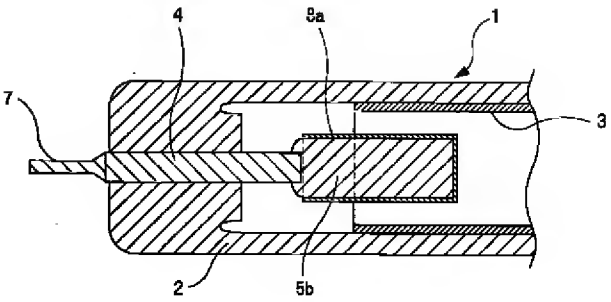
【図１】



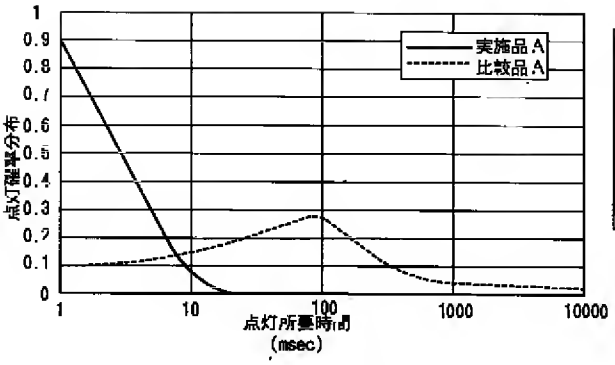
【図２】



【図５】



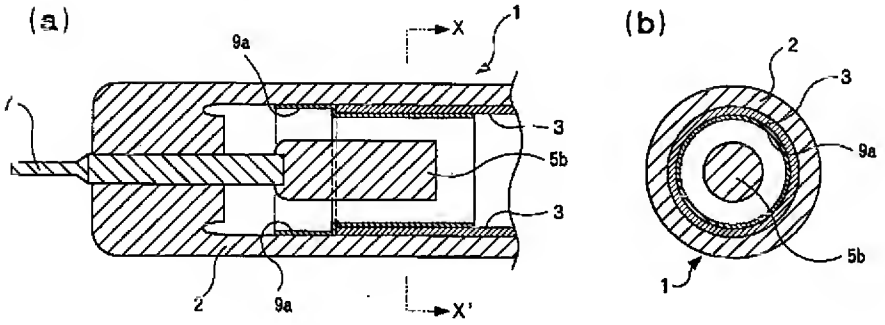
【図3】



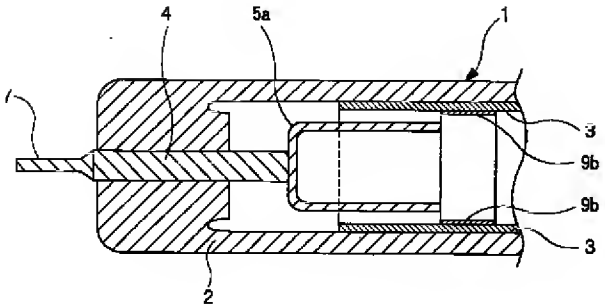
(msec)

点灯時間	実施品A	比較品A
1	0.9	0.1
10	0.08	0.14
50	0.01	0.24
100	0.01	0.27
250	0	0.13
500	0	0.06
1000	0	0.04
10000	0	0.02

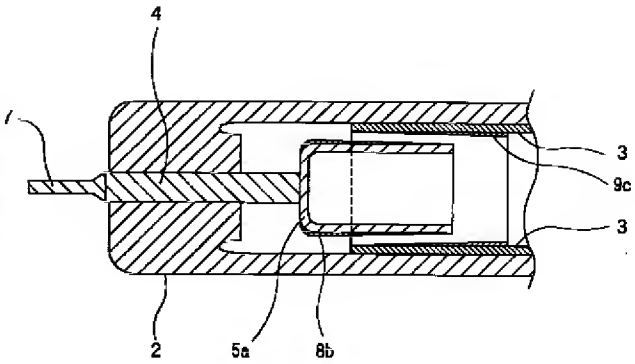
【図4】



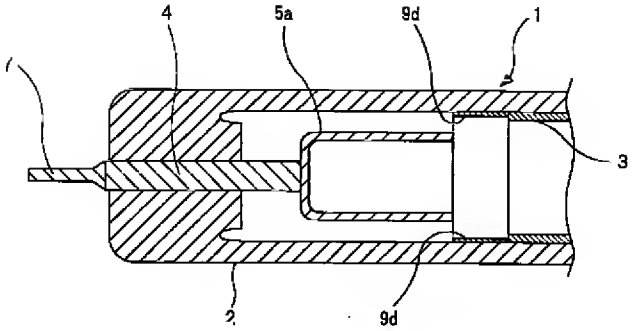
【図6】



【図7】



【図8】



【図9】

暗黒始動遅れ時間（m秒）	実施品A	比較品B	実施品C	実施品D	実施品E
平　均	100	115	250	70	30
最　大	280	6030	480	150	120
最　小	0	20	50	0	0

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